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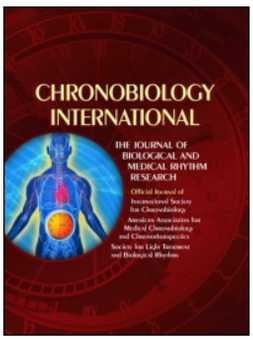

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ORIGINAL ARTICLE

Association between overuse of mobile phones on quality of sleep and general health among occupational health and safety students

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ABSTRACT

Concerns about health problems due to the increasing use of mobile phones are growing. Excessive use of mobile phones can affect the quality of sleep as one of the important issues in the health literature and general health of people. Therefore, this study investigated the relationship between the excessive use of mobile phones and general health and quality of sleep on 450 Occupational Health and Safety (OH&S) students in five universities of medical sciences in the North East of Iran in 2014. To achieve this objective, special questionnaires that included Cell Phone Overuse Scale, Pittsburgh's Sleep Quality Index (PSQI) and General Health Questionnaire (GHQ) were used, respectively. In addition to descriptive statistical methods, independent *t*-test, Pearson correlation, analysis of variance (ANOVA) and multiple regression tests were performed. The results revealed that half of the students had a poor level of sleep quality and most of them were considered unhealthy. The Pearson correlation co-efficient indicated a significant association between the excessive use of mobile phones and the total score of general health and the quality of sleep. In addition, the results of the multiple regression showed that the excessive use of mobile phones has a significant relationship between each of the four subscales of general health and the quality of sleep. Furthermore, the results of the multivariate regression indicated that the quality of sleep has a simultaneous effect on each of the four scales of the general health. Overall, a simultaneous study of the effects of the mobile phones on the quality of sleep and the general health could be considered as a trigger to employ some intervention programs to improve their general health status, quality of sleep and consequently educational performance.

KEYWORDS

Cell phones; general health; quality of sleep; students

Introduction

In the recent decade, mobile phones have formed the most essential part of human life (Kenichi, 2011). International studies which were conducted in 2007 showed that mobile phones for adults were considered as the most important communicational means (Kenichi, 2011). In view of popularity and dramatic increase in the use of mobile phones in adolescents, there exist some serious and considerable concerns in the societies about their negative effects on human's health (Kenichi, 2011). Based on the extent of using this technology among developing countries, one of the concerns of World Health Organization (WHO) is that any adverse effects on health resulting from the use of mobile phones can cause some concern in the world. So, even a small adverse effect on the health of an individual can have a major impact on the public health of the community (Repacholi, 2001). High quantity of mobile phone exposure can cause adverse effects such as heating of tissue, neural activity and disturbances in concentration (Khan, 2008; Repacholi, 2001), while clear evidence does not exist about the physiological adverse effect due to exposure to the microwaves through the usage of mobile phones (Khan, 2008).

In addition, mostly in recent years, many people have complained that they have used mobile phones and have experienced health disorders like headache, sleep problems, dizziness, rashes, decentralization, impairment of short-term memory, blood pressure and forgetfulness (Al-Muhayawi et al., 2012; Thomée et al., 2011). However, investigating the health risks due to the exposure to the

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electromagnetic waves mostly has focused on three main areas like carcinogenetic, bio regulatory and impaired well-being and sleep disorders (Al-Muhayawi et al., 2012). Sleep disorders may trigger serious physical and mental issues. In fact, sleep disorder is prevalent not only among adolescents but also in juveniles (Munezawa et al., 2011). There is a direct relation between the life style of people and their quality of sleep (Munezawa et al., 2011). Sleep disturbance can be one of the consequences of excessive use of mobile phones (Thomée et al., 2011). Also, there are various studies on Finnish adolescents that focused on the relationship of mobile usage and sleep pattern which showed the longer usage of mobile phones, the shorter sleep time (Cain & Gradisar, 2010). Another research amongst Japanese young people who used mobile phones every day showed that they usually got up later, their sleep time was shorter and they were dissatisfied compared to those who did not use mobiles during the day (Cain & Gradisar, 2010).

As mentioned above, according to the serious concerns about the effects of using mobile phones on health and quality of sleep, the present study was conducted to better understand the situation of excessive use of mobile phones among students and their effects on students' health. Moreover, regarding the fact that sleep disorder can be considered as one of the factors affecting health, this study, for the first time in Iran, investigated the association between the excessive use of mobile phones and the quality of sleep and general health simultaneously.

Materials and methods

This was a cross-sectional study that was conducted on all qualified Occupational Health and Safety (OH&S) students, who were undergraduate at five universities of medical sciences in the North East of Iran in 2014. In this study, 470 students were eligible, 20 of whom, due to the lack of cooperation or failure in completing the questionnaires, were excluded. So, the investigation was performed on 450 students. The inclusion criterion was possessing mobile phones for more than 6 months and exclusion criteria were failing in filling up the questionnaires (answering less than 50% of the questions) and unwillingness to participate in the study. The tools of data collection were three separate questionnaires derived from Pittsburgh's Sleep Quality Index (PSQI), General Health Questionnaire (GHQ) and Cell Phone Overuse Scale (Assaad et al., 2014) which were distributed among the participants after briefing them about the goal of the research and how to fill up the questionnaires.

To assess the quality of sleep, PSQI, which consisted of 19 questions, was used. The answers to 5 of the 19 questions were in numerical and the rest in 4-point Likert Scale (from "Not During the Past Month" to "Three Times or More During the Week"). This questionnaire investigates seven components of sleep quality which consisted of (1) sleep quality, (2) sleep onset latency, (3) sleep duration, (4) sleep efficiency, (5) sleep disturbance, (6) use of sleep medication and (7) daytime dysfunction. The validity and the reliability of the questionnaire have been approved through several different studies (Backhaus et al., 2002). The score range in this questionnaire is extended from 0 to 21; 0–5: good sleep quality, 6–10: less than moderate sleep quality and 11–21: poor sleep quality (Buysse et al., 1989).

To assess the general health, Goldenberg & Hiller's questionnaire was used in order to identify the mental disorders and evaluate the state of psychological health (Goldberg & Hillier, 1979). This questionnaire had 28 questions which were in the form of the 4-point Likert Scale (from "Not At All" to "Much More Than Usual") and 4 subscales including: (1) somatic symptoms, (2) social dysfunction, (3) anxiety and insomnia and (4) severe depression, each of which proposed seven questions. The subscale score varied from 0 to 21; 0–7: unhealthy, 8–14: at risk and 15–21: healthy. The total score of the questionnaires has been calculated by the sum of the four subscales as follows; 0–28: unhealthy, 29–56: at risk and 57–84: healthy.

The validity and the reliability of GHQ in Iranian society which has been approved through three methods such as test–retest reliability, split-half reliability and Cronbach alpha co-efficient by Taghavi were 0.9, 0.93 and 0.7, respectively (Taghavi, 2001).

To investigate the over use of mobile phones, Janaro et al.'s questionnaire was used. It consisted of 21 questions in the form of the 6-point Likert Scale, from "Never" to "Always". Validation of the Persian version of the questionnaire was examined by Golmohammadian & Yyaseminejad (2011),

whose validity and reliability had also been evaluated and approved. Its validity by Cronbach alpha was 0.903 and its reliability by test–retest was 0.714 ($p \leq 0.005$) (Golmohammadian & Yyaseminejad, 2011). Scores over 75 were considered as "Excessive User", accordingly less than 25 were considered as "Rare User" (Golmohammadian & Yyaseminejad, 2011).

In addition to the three questionnaires above, there were 10 questions about the demographic information, education level, accommodation information and so on.

Taking part and answering the questions were based on the informed consent of the individuals and the research group is committed to maintain the information and publish the results confidentially. The data was analyzed using SPSS version 16 (Chicago, SPSS Inc.). In addition to descriptive statistical methods, independent *t*-test, Pearson correlation, ANOVA and multiple regression test were performed. The significant level in the present study was set at $p < 0.05$.

Results

The mean age of the participants was 20.4 ± 1.6 years. (range: 18–28 years) and regarding their marital status, most of the participants were single (66.5%) and female (64%).

Although, computing the average rates of COS based on demographic variables showed that the average rates of mobile phones use in all groups of variables was moderate (score; 25–75), there was a significant difference among both the dwelling type and the resident status groups ($p = 0.043$) with COS.

Mean scores of GH in terms of demographic variables showed that the average score in all groups of studied variables, except for the fourth-year students, who are at risk, was less than 28, which indicates the unhealthy status of Occupational Health and Safety students. In other words, general health status of students was not healthy in each group of demographic variables. In this case, students who were the fourth-year (9.82 ± 7.86) and females (16.83 ± 12.45) have the lowest mean score of general health, respectively. However, the results showed that variables of university, sex and dwelling type had a significant effect on GH of students ($p < 0.05$).

Although the mean score of PSQI according to demographic variables indicated that sleep quality in all groups was moderate (score; 5–10), the mean score of PSQI had a significant difference in sex, university, year of study, dwelling type and residence type groups ($p < 0.05$, Table 1).

Table 1. Relationship between COS, GH and PSQI with the demographic variables.

			COS		GH		PSQI	
Variable	Group	Number (%)	Mean ± SD	*p* value	Mean ± SD	*p* value	Mean ± SD	*p* value
Age*	=<20	250 (55.56)	41.99 ± 15.44	0.978	22.08 ± 13.08	0.598	5.73 ± 3.03	0.065
	=>21	200 (44.44)	42.04 ± 15.28		22.98 ± 12.34		6.49 ± 3.13	
Sex*	Female	288 (64.0)	43.02 ± 15.88	0.234	25.67 ± 11.79	<0.001	5.52 ± 3.22	0.006
	Male	162 (36.0)	40.48 ± 14.26		16.83 ± 12.45		5.26 ± 2.67	
University**	A	95 (27.4)	43.30 ± 15.70	0.785	21.73 ± 11.47	<0.001	5.61 ± 2.62	0.019
	B	90 (18.7)	42.27 ± 15.07		26.16 ± 13.89		6.58 ± 3.38	
	C	85 (34.8)	42.27 ± 16.12		25.03 ± 11.36		6.53 ± 3.18	
	D	100 (7.0)	38.75 ± 11.54		24.93 ± 14.87		6.12 ± 3.51	
	E	80 (12.2)	39.89 ± 15.07		9.82 ± 7.86		5.01 ± 2.84	
Year of study**	1 year	213 (47.3)	42.84 ± 16.81	0.360	22.13 ± 13.62	0.233	5.73 ± 2.98	0.024
	2 year	107 (23.7)	43.94 ± 13.54		21.20 ± 11.33		6.43 ± 3.85	
	3 year	112 (25.0)	38.10 ± 13.47		23.21 ± 11.63		6.42 ± 2.59	
	4 year	18 (4.0)	45.22 ± 15.84		29.88 ± 15.83		5.66 ± 1.80	
Marital status*	Single	300 (66.5)	42.17 ± 15.83	0.455	22.64 ± 13.06	0.228	5.94 ± 2.91	0.720
	Married	150 (33.5)	41.33 ± 13.04		21.73 ± 11.28		6.64 ± 3.76	
Dwelling type**	Dormitory	220 (49.0)	44.46 ± 16.75	0.043	24.76 ± 12.92	0.032	6.56 ± 3.48	0.032
	Rented house	135 (30.0)	40.73 ± 14.40		20.05 ± 12.30		5.64 ± 2.38	
	With family	95 (21.0)	38.20 ± 12.16		20.57 ± 12.21		5.51 ± 2.85	
Residence status*	Permanent	143 (31.7)	38.60 ± 13.74	0.021	21.79 ± 13.05	0.578	5.71 ± 2.91	0.043
	Temporary	307 (68.3)	43.61 ± 15.82		22.80 ± 12.62		6.23 ± 3.16	

*Independent samples test, **ANOVA., age = (20.40 ± 1.60, range; 18–28 years)
COS; cell phone over use scale, GH; general health, PSQI; Pittsburgh sleep quality index

Results show that although about half of participants (50.4%) had good quality of sleep and most of them had medium use (84.6%) of mobile phones, but, only about 0.4% of the participants were healthy and about 31.3% and 68.3% were at risk and unhealthy. These are based on scores from questionnaires and not on any kind of comprehensive physical examination from a physician (Table 2).

Investigating the relationship between the COS and the general health through the Pearson correlation coefficient (PCC) showed that the COS with the total score of general health and all of its four subscales had a significant relationship ($p < 0.001$) (Table 3).

The results of multiple regression showed that the impact of each four general health subscales was exclusively significant on COS. This relation is implied vice versa; cell phone overuse was significantly different ($p < 0.001$) on each of the general health subscales (Table 4).

A further analysis with the aim of investigating the simultaneous impact of the COS on each subscales of the general health through the multivariate regression showed that it had a significant effect on social dysfunction ($p = 044$) and depression subscales ($p = 009$). However, its effect on somatic symptoms and anxiety subscales are not significant ($p > 0.05$) (Table 5).

The result of PCC test showed that the COS had significant relationship with the quality of sleep ($R^2 = 0.083$). This relationship was also significant with four components of quality of sleep that include: sleep latency ($p < 0.001$), sleep disturbance ($p < 0.001$), daytime dysfunction ($p < 0.001$) and use of sleep medication ($p = 0.007$). In addition, the results of multiple regression showed that the effect of the COS on the quality of sleep was significantly different ($p < 0.001$, $R^2 = 0.083$). However, the effect of COS on the components of subjective sleep quality, sleep duration and sleep efficiency is not significant ($p > 0.05$) (Table 6). Also, the results of Multivariate Analysis showed that adjusted PSQI global had significant relationship with the COS ($R^2 = 0.181$, $p = 0.002$).

Table 2. Frequency of GH, COS and PSQI in the study population.

	GH			COS			PSQI	
Level	Unhealthy	At risk	Healthy	Low use	Medium use	Overuse	Good	Poor
Frequency	307	141	2	49	380	21	227	223
Percent	68.3	31.3	0.4	10.8	84.6	4.6	50.4	49.6

Table 3. Relationship between COS and GH global and its four subscales.

		Somatic symptoms	Anxiety	Social dysfunction	Depression	GH global
COS	Pearson correlation	0.242	0.266	0.222	0.255	0.427
	p value	<0.001	<0.001	0.001	<0.001	<0.001

Table 4. Multiple regression between COS and GH subscales.

	Unstandardized coefficients		Standardized coefficients		
Independent variables	B	Std. Error	Beta	*t*	*p* value
Somatic symptoms	1.001	0.267	0.242	3.751	<0.001
Anxiety	1.038	0.250	0.266	4.145	<0.001
Social dysfunction	0.959	0.280	0.222	3.422	0.001
Depression	0.926	0.233	0.255	3.972	<0.001

Dependent variable: COS

Table 5. Multivariate regression between COS and four subscales of general health.

Independent variable	Dependent variable	Sum of squares	df	Mean square	R^2	*F*	*p* value
COS	Somatic symptoms	933.365	55	16.970	0.298	1.326	0.088
	Anxiety	1016.402	55	18.480	0.289	1.271	0.125
	Social dysfunction	898.586	55	16.338	0.313	1.427	0.044
	Depression	1400.630	55	25.466	0.343	1.634	0.009

Table 6. Association between MPUOS and seven components of PSQI.

								PSQI global			Adjusted PSQI global	
	SSQ	SL	SD	SE	SD	USM	DD	PCC	Multiple regression		Multivariate analysis	
PCC	−0.028	0.381	0.031	0.030	0.270	0.179	0.277	0.288	B	P	B	P
p	0.678	<0.001	0.637	0.663	<0.001	0.007	<0.001	<0.001	0.047	<0.001	0.041	0.002

PCC, Pearson correlation coefficient; *p*, *p* value; SSQ, subjective sleep quality; SL, sleep latency; SD, sleep duration; SE, sleep efficiency; SD, sleep disturbance, SUM, use of sleep medication; DD, daytime dysfunction.
Dependent variable, PSQI; predictors (constant), COS.

Table 7. Relationship between PSQI and GHQ subscales.

					GH global			
	Somatic symptoms	Anxiety	Social dysfunction	Depression	Pearson correlation	Multiple regression		
Pearson correlation	0.238	0.260	0.226	0.268	0.302	B	F	*p* value
p value	<0.001	<0.001	0.001	<0.001	<0.001	0.073	22.867	<0.001

Dependent variable: PSQI, Predictors: (constant), GH

Table 8. Multivariate regression between PSQI and four subscales of GHQ.

Independent variable	Dependent variable	Sum of squares	df	Mean square	R^2	*F*	*p* value
PSQI	Somatic symptoms	429.032	14	30.645	0.136	2.411	0.004
	Anxiety	633.781	14	45.270	0.178	3.334	<0.001
	Social dysfunction	449.806	14	32.129	0.156	2.840	0.001
	Depression	652.014	14	46.572	0.159	2.896	<0.001

The Pearson correlation showed that the quality of sleep had significant relationship with the overall score of general health and each of its subscales. Furthermore, multiple regression showed that the students' general health had a meaningful relationship with their quality of sleep ($p < 0.001$, $R^2 = 0.091$) (Table 7).

Multivariate regression analysis showed that the simultaneous effects of participants' quality of sleep on each subscales of their general health are significant and this relationship is strong between the sleep quality of the participants and the anxiety and depression subscale ($p < 0.001$) (Table 8).

Discussion

Investigating the relationship between the demographic characteristics and each of the questionnaires showed that there is a meaningful relationship between the residence status and the dwelling type and the excessive use of mobile phones. This is probably because the students who lived in the dormitory far from their family had to use mobile phones excessively. Also, the demographic characteristics including sex, year of study, dwelling type and residence status have a significant relationship with the quality of sleep that is similar to the findings of Suen et al. (2010) which was conducted among Hong Kong students.

Almost half of the students in this study had poor quality of sleep and the majority were unhealthy that could be related to their life style and were in the range of medium use of mobile phones. These findings are based on the results of questionnaires and medical examinations were not administered on participants. A study that was conducted by Assaad et al. (2014) among Lebanese students found that less than half of the students were good sleeper (Assaad et al., 2014). The results also showed that there exists a positive meaningful relationship between the total score and the general health subscales because of the excessive use of mobile phones. This study is aligned with the studies which were conducted by Santini et al. (2002) and Roosli et al. (2002) which concluded that being imposed to electromagnetic fields emitted from mobile phones resulted in some symptoms like depression and anxiety (Roosli et al., 2002; Santini et al., 2002). Several studies have shown that there is a significant relationship between the length of time in using mobile phones and the anxiety in the students (Ezoe et al., 2009; Hamblin & Wood, 2002; Westerman & Hocking, 2004). In other words, more use of mobile phones resulted in more

anxiety and more stress as well as in negative effects on the brain activity. In this study, despite the fact that our findings showed a relationship between excessive use of mobile phones and anxiety, the multivariate regression did not prove it. So, there seems to be a need for further survey in this area.

Several studies were conducted from the perspective of effects of somatic symptoms of excessive use of mobile phones. They reported that excessive use of mobile phones leads to symptoms such as headache, memory loss and fatigue (Oftedal et al., 2000; Westerman & Hocking, 2004; Yioultsis et al., 2002). Moreover, Toda et al. (2006) conducted a study which reported that the excessive use of mobile phones may have a negative impact on a healthy lifestyle (Toda et al., 2006). Therefore, one of the reasons that the majority of the students in our study were unhealthy could be related to the somatic symptoms which had significant relation to general health and excessive use of mobile. Overall, the findings of this study about the impact of the excessive use of mobile phones on the physical and psychological health confirmed the findings of Jenaro et al. (2007) and Kamibeppu and Sugiura (2005). The present study suggested that there is a significant relationship between social dysfunction and the excessive use of mobile phones that is in line with Austin's study (Austin, 2001). This may be due to the poor quality of sleep that will be discussed as follows.

The other side effect of the excessive use of mobile phones that was investigated in the present study is sleep disorder. Mann and Röschke (2004) states that sleep disorders is not the major symptom of using mobile despite the complaints that people have raised in this area (Mann & Röschke, 2004). However, in a study by Assaad et al. (2014) which investigated the habits and sleep disorders among students, it was found that sleep disorders might lead to problems in daily functioning such as driving and education (Assaad et al., 2014). The results in the present study showed that people who frequently use mobile phones have lower sleep quality. Perhaps it was because of calling by mobile phones at night (Munezawa et al., 2011). Due to the effects of sleep habits such as regularity of sleep, sleep time and sleep duration on the quality of sleep, a careful interpretation was performed in order to adjust sleep habit variation by multivariate analysis. In this case, the relationship between sleep quality and excessive use of mobile phones also was significant ($p = 0.002$, Table 6).

The correlation coefficient indicates the direction of the relationship between two variables and its value is between −1 and 1. –The closer to one, the stronger the relationship and of course the negative sign indicates a reverse relationship. In the present study, although the relationship between sleep quality and excessive use of mobile phones, except subjective sleep quality, with all other aspects are positive but its intensity in all components is moderate or low. However, Pearson's Correlation Coefficient shows significant relationship between the excessive use of mobile phones and four out of seven component of sleep quality ($p < 0.001$). Also, the regression results showed a significant and positive relationship between the excessive use of mobile phones and global index of students sleep quality (Table 6). Regarding the relationship between general health and quality of sleep, however, the correlation coefficient between each of the four general health subscales were low but there was a significant correlation between them ($p < 0.001$) and multiple regression analysis showed that global general health were significantly associated with sleep quality (Table 7). Some studies have examined the association between quality of sleep and general health (Baglioni et al., 2010; Hayashino et al., 2010; Kaneita et al., 2009; Sasai et al., 2010) which showed the same results as this study.

It is important to note various limitations of the current study and directions for further research. This study included both a self-reported answers and a cross-sectional design. Another limitation of this study included exposure to the light of mobile phones at night and the sound level. In addition, the overnight activity of young people without sleep at night time could be considered as an effective factor, although issue has not been raised in this study. Considering the fact that the data were collected through self-report in the present study, it is suggested that future experimental studies be conducted under the controlled conditions regarding biological and psychological impacts of the Electromagnetic field on the health and the quality of sleep.

Dramatic improvement in the communication industry and the probability of emerging negative effects on the human's health through excessive use of mobile phones have led to significant attention to this issue. On the basis of the findings of the present study, excessive use of mobile phones could have negative effects on general health and quality of sleep which can happen as a result of potential capability for addiction of using mobile phones and changing behavioral patterns like staying up late and being busy with calling. Thus, it is recommended that by using mobile phones moderately, training the principles of sleep hygiene through intervention programs and considering the significant role of sleep on the human's health, we may prevent or reduce the students' problems such as physical and psychological health issues and the drop in education.

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Declaration of interest

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